VOL. 46 OCTOBER 1919 NO. 10

GENERAL LIBRARY
NOV 8 1919
UNIV. OF MICH.
SCIENCE LIBRARY

BULLETIN

OF THE

TORREY BOTANICAL CLUB

Editor

ALEXANDER WILLIAM EVANS

Associate Editors

JEAN BROADHURST
JAMES ARTHUR HARRIS
MARSHALL AVERY HOWE
MICHAEL LEVINE
GEORGE ELWOOD NICHOLS
ARLOW BURDETTE STOUT
NORMAN TAYLOR

CONTENTS

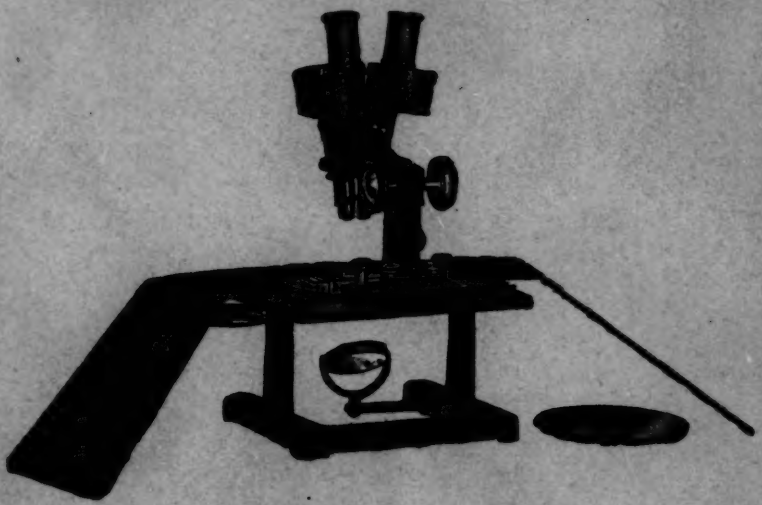
Studies in the genus Lupinus—IV. The Pusilli. CHARLES PIPER SMITH 389

Grass rusts of unusual structure . . . . J. C. ARTHUR and E. B. MAINS 411

INDEX TO AMERICAN BOTANICAL LITERATURE 417

PUBLISHED FOR THE CLUB
THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

Large Dissecting Stand



A new design which meets every requirement by reason of its large size and wide range of usefulness. Accommodates interchangeably Binocular Microscope body (illustrated), Monocular Erecting Body, using medium high power objectives, or simple lens in jointed arm—all focused by rack and pinion. The microscope bodies may be mounted on a sliding track, permitting the entire width of the stage to be covered.

Stage, 8x7 inches, is provided with glass and metal plates, 4¼ inches in diameter, and with adjustable background stops beneath.

With 38 and 19 mm. doublet lenses $31.90

With Binocular Microscope body, 40 mm. objectives and 10X eyepieces, as illustrated above $87.50

Write for illustrated circulars.

Bausch & Lomb Optical Co.

NEW YORK WASHINGTON CHICAGO SAN FRANCISCO
LONDON ROCHESTER, N.Y. FRANKFORT

Vol. 46 No. 10

BULLETIN

OF THE

TORREY BOTANICAL CLUB

OCTOBER, 1919

Studies in the genus Lupinus—IV. The Pusilli

CHARLES PIPER SMITH

(WITH TEN TEXT FIGURES)

INTRODUCTION

In my second and third papers of this series (Bull. Torrey Club **45**: 1–22, 167–202. 1918), I treated the *Microcarpi*, the larger and more neglected division of Watson's subgenus *Platycarpos*, and I now present my review of the species and varieties properly to be included in the smaller and much less neglected group, the *Pusilli*.

The following list includes the published names that need to be considered in this paper:

L. pusillus Pursh, Fl. Am. Sept. **2**: 468. 1814.
L. brevicaulis Wats. Bot. King's Report 53. 1871.
L. Kingii Wats. Proc. Am. Acad. **8**: 534. 1873.
L. Sileri Wats. *ibid.* **10**: 345. 1875.
L. Shockleyi Wats. *ibid.* **22**: 470. 1887.
L. capitatus Greene, Pittonia **1**: 171. 1888.
L. odoratus Heller, Muhlenbergia **2**: 71. 1905.
L. scaposus Rydberg, Bull. Torrey Club **34**: 45. 1907.
L. rubens Rydberg, *ibid.* **34**: 45. 1907.
L. dispersus Heller, Muhlenbergia **5**: 141. 1909.
L. flavoculatus Heller, *ibid.* **5**: 149. 1909.
L. intermontanus Heller, *ibid.* **8**: 87. 1912.
L. argillaceus Woot. & Standl. Contr. U. S. Nat. Herb. **16**: 1913.

In my discussion of *L. malacophyllus* Greene, I indicated a disposition to question the inclusion of this species in the *Micro-*

[The BULLETIN for September (**46**: 337–388. *pl. 14–16*) was issued October 17, 1919.]

carpi, but so placed it on the basis of its verticillate inflorescence. The non-ciliate keel and the floral bracts, however, connect it with the *Pusilli*. To contrast it further with *L. subvexus transmontanus* C. P. Smith (Bull. Torrey Club **45**: *f. 10*), with which it is confused, I insert here drawings of my own, FIG. 43. I now consider it better to compromise the situation by recognizing three divisions of the subgenus, and accordingly propose the following classification:

Flowers not verticillate; keel glabrous.	PUSILLI.
Flowers, at least the lower, in whorls.	
Keel glabrous; flowers 10–12 mm. long.	MALACOPHYLLI.
Keel ciliate above near claw; flowers 11–19 mm. long.	MICROCARPI

GEOGRAPHICAL DISTRIBUTION

The *Pusilli* are peculiar to western North America. Typical *L. pusillus* is primarily a species of the Atlantic drainage of the Rockies, from Alberta and North Dakota to western Kansas

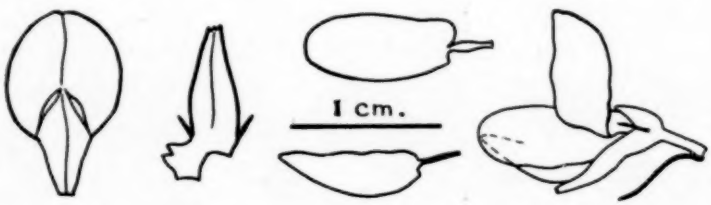


FIG. 43. LUPINUS MALACOPHYLLUS Greene. *A. A. Heller 9696* (CPS).

and New Mexico. All the other forms of the group, however, are plants of the Great Basin and Mexican Plateau, from central Washington and southwestern Wyoming to Arizona and southern California.

DIAGNOSTIC CHARACTERS

Authors' "original descriptions" are not reprinted in this paper. The diagnoses here presented have no pretense of being complete, but are intended to sum up briefly the seemingly more dependable characters. These descriptions, therefore, allow for the evident variations observed by me in the specimens listed.

The upper calyx-lip calls for special mention. While this seems to be relatively constant in size and shape in most of the forms of this group, its variability in *L. brevicaulis* should be duly

recognized. This variability parallels equal diversity in *L. subvexus* and *L. densiflorus*, as recently shown by me (Bull. Torrey Club **45**: 5. *f. 7, 16, 24, 30, 31, 35,* and *42*). In like manner, variations in length of peduncles and details of branching are not accepted by me as specific in character unless supported by recognizable differences in the floral parts or fruits. This conclusion is followed in my treatment of the variable *L. Kingii*, where these variations are evidently superficial rather than fundamental.

My measurements of the floral parts are from the softened material, mounted in water, hence should agree rather with the fresh flowers than with dried material. An allowance of about 10 per cent should be made when measurements of dried flowers are compared with my figures.

MATERIAL EXAMINED AND CITED

Seven institutions have contributed to this paper by making it possible for me to examine their specimens of this group. The names of these institutions are given below, with the respective abbreviations used in the citations. "CPS" indicates that the specimen cited is in the private collection of the writer, and "FS" indicates a specimen owned by the United States Forest Service.

B, Brooklyn Botanic Garden;
CAC, Colorado Agricultural College;
G, Gray Herbarium of Harvard University;
NY, New York Botanical Garden;
RM, Rocky Mountain Herbarium, University of Wyoming;
T, Torrey Herbarium (at New York Botanical Garden);
UC, University of California;
US, United States National Herbarium.

Key to the species and varieties of the Pusilli

Flowers usually crowded into head-like racemes.
- Stems short, seldom over 1 cm. long; leaves crowded basally; upper calyx-lip not over 2 mm. long, bifid, two-lobed or nearly obsolete. — 8. *L. brevicaulis.*
- Stems elongated, several cm. long; leaves scattered; upper calyx-lip 3–6 mm. long, bifid.
  - Pubescence copious, that of the pedicels and calyx long and spreading. — 7a. *L. Kingii.*
  - Pubescence scant, that of the pedicels and calyx short and appressed. — 7b. var. *argillaceus.*

Flowers scattered in elongated racemes.
  Flowers distinctly ascending in anthesis. 8. [*L. scaposus.*]
  Flowers spreading in anthesis.
    Rather densely pubescent with hairs about 1 mm. long; pods smooth or scaly on the sides.
      Flowers about 6 mm. long; banner angled at apex; pods ovate, 10–15 mm. long; ovules two. 9. *L. Shockleyi.*
      Flowers 10–12 mm. long; banner rounded at apex; pods oblong, about 20 mm. long; ovules two–four. 10*b*. var. *pilosellus.*
    Loosely villous or varying to glabrate.
      Stems almost or quite glabrous, calyx strictly so; pods oblong, smooth or scaly on the sides, about 20 mm. long, ovules two–six; seeds 2–3 mm. across. 10*a*. *L. odoratus.*
      Stems obviously villous, at least the lips of the calyx villous; pods usually villous on the sides; ovules mostly two.
        Racemes obviously exceeding the foliage; pods ovate, about 10 mm. long, loosely villous on the sides; seeds 2–3 mm. across.
          Branches tardily developing, the axial peduncle erect and early-flowering. 11*a*. *L. rubens.*
          Branches early-developing, all floriferous and widely-spreading. 11*b*. var. *flavoculatus.*
        Racemes equalled or surpassed by the foliage; pods lance-oblong, usually somewhat constricted near the middle, shaggy on the sides, about 20 mm. long; seeds about 4 mm. across.
          Flowers 10–12 mm. long; lower calyx-lip over twice as long as wide. 12*a*. *L. pusillus.*
          Flowers 7–8 mm. long; lower calyx-lip barely twice as long as wide. 12*b*. var. *intermontanus.*

7*a*. LUPINUS KINGII Wats. Proc. Am. Acad. **8**: 534. 1873. [FIG. 44].

Lupinus Sileri Wats. *ibid.* **10**: 345. 1875 (in part).

Lupinus capitatus Greene, Pittonia **1**: 171. 1888.

Stems well-developed, erect with ascending branches or varying to widely spreading, 1–4 dm. tall, branched at the base or more commonly well above the base, spreading-villous; leaves usually

scattered, glabrous above or more or less hairy; peduncles variable in length, the short capitate or subcapitate racemes exceeding the foliage or surpassed by same; flowers crowded, 10–11 mm. long, commonly few; pedicels 1–2 mm. long, villous; calyx bracteolate, villous, upper lip 4–7 mm. long, bifid, the divisions slender, lower lip 5.5–7 mm. long, three-toothed; petals blue or purple, narrow, banner 8–10 mm. long, 3–5 mm. wide, usually acute at apex, wings 6–8 mm. long, 2–3.5 mm. wide, oval or oblong, keel straight, 6–8 mm. long, about 3 mm. wide; pods rhombic-ovate, about 10 mm. long; seeds about 2 × 2.5 mm.

Watson soon recognized the affinity of his supposed perennial, *L. Kingii*, and his annual, *L. Sileri*, and reduced the latter to synonymy. This viewpoint has been followed by Coulter (Man. Bot. Rocky Mts. 273. 1885), Coulter and Nelson (New Man. Rocky Mt. Bot. 469. 1909), Rydberg (Fl. Colo. 100, 1906; Fl.

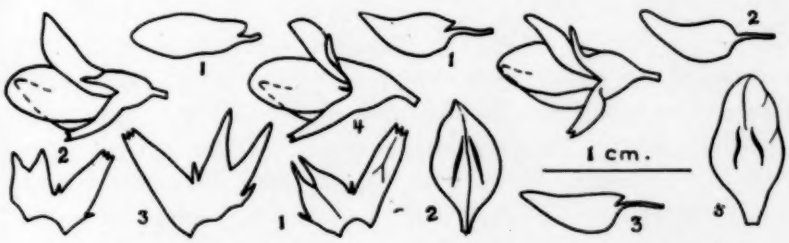


FIG. 44. LUPINUS KINGII Wats. 1. *Korstian & Baker 131* (FS); 2. *C. A. Purpus 8083* (US); 3. *S. Watson 234* (US); 4. *C. F. Baker 439* (US); 5. *M. E. Jones 5641* (US).

Rocky Mts. 469. 1917), and Heller (Muhlenbergia **6**: 71. 1910). Heller and Rydberg have also referred Greene's *L. capitatus* to Watson's species. Wooton and Standley (Contr. U. S. Nat. Herb. **19**: 340. 1915), however, have recognized *L. Kingii* and *L. Sileri* as distinct species, each represented in New Mexico, and have segregated *L. argillaceus* as a new species. My study of the specimens listed below prevents my recognition of more than one species here, though as least one variety probably deserves attention. I can not see specific characters in the variations in length of peduncles, or in the extremes of types of branching (widely divaricate to ascending) here; but the more sharply defined variation in pubescence seems to be of sufficient definition for use in varietal recognition. Greene attributes to *L. capitatus*

an "entire" lower calyx-lip; but the several Coconino County specimens examined by me have the normal three-toothed lower lip.

UTAH. Beaver County: Beaver, Aug., 1882, *M. E. Jones* (G). Garfield County: Panguitch Lake, 7 Sept., 1894, *M. E. Jones 60151* (US). Piute County: Grass Valley, *L. F. Ward 648* (US); Grass Valley, Aug., 1882, *Powell Exped., L. F. Ward* (G). San Juan County: mesa east of Monticello, July, 1911, *P. A. Rydberg & A. O. Garrett 9214* (US, NY). Sevier County: Burrville, July, 1894, *M. E. Jones 5641* (US, RM); Loa Pass, July, 1894, *M. E. Jones 5641* (NY, UC); Fish Creek Canyon, July, 1909, *A. O. Garrett 2532* (NY). Summit County: Parley's Park, July, 1869, *S. Watson 234* (US). County not given: 1872, *Capt. Bishop* (US); Juniper Mountains, 1898, *C. A. Purpus 6256* (US).

COLORADO. Archuleta County: Piedra, July, 1899, *C. F. Baker 439* (G, NY, RM, US); Pagosa Springs, Aug., 1904, *E. O. Wooton* (US). Costilla County: Garland, July, 1896, *C. L. Shear 3682* (NY); San Acacio, Culebra Creek, July, 1912 *E. R. Warren* (RM). Delta County: without definite locality, June, 1892, *J. H. Cowen* (US). Gunnison County: Gunnison Watershed, July, 1901, *C. F. Baker 452* (G, NY, RM, UC, US). LaPlata County: Durango, July, 1896, *F. Tweedy 452* (US). LaPlata or Montezuma County: Parrott City, Rio Mancos trail July, 1875, *Hayden Survey 1197, T. S. Brandegee* (UC); trail, between Rio de los Mancos and Rio la Plata, July, 1875, *T. S. Brandegee* (G); Thompsons Park, LaPlata Mountains, July, 1898, *C. F. Baker, F. S. Earle, & S. M. Tracy 441* (G, NY, UC, US). County not given: Colfax, Sept., 1877, *T. S. Brandegee* (UC); 1896 *F. Clements 318* (NY).

NEW MEXICO. Bernalillo County: Tijeras, Sandia Mountains, May, 1914, *C. C. Ellis 430* (US). Dona Ana County: Organ Mountains, May, 1905, *E. O. Wooton* (RM). Grant County: GOS Ranch, Aug.–Sept., 1911, *J. M. Holzinger* (US). McKinley County: Cooledge [Guam], July, 1889, *M. Hopkins* (US). Rio Arriba County: vicinity of Chama, July, 1911, *P. C. Standley 6793* (US); Dulce, Jicarilla Apache Reservation, Aug., 1911, *P. C. Standley 8071* (US); El Rito, Aug., 1904, *E. O. Wooton* (US). Sandoval County: Rito de las Frijoles, Aug., 1902, *T.*

D. A. Cockerell 19 (US); Rito de las Frijoles, Aug., 1910, *W. W. Robbins* (RM). San Juan County: Tunitcha Mountains, Aug., 1911, *P. C. Standley 7786* (US). Socorro County: Mogollon Mountains, middle fork of the Gila, Aug., 1900, *E. O. Wooton* (US); Wheelers Ranch, July, 1906, *E. O. Wooton* (RM, US).

ARIZONA. Apache County: White Mountains, Aug., 1903, *D. Griffiths 5273* (US); Alpine, July, 1912, *L. N. Goodding 1258* (RM). Cochise County: Bisbee, July, 1912, *L. N. Goodding 1258* (US). Coconino County: Cosnino, July, 1883, *H. H. Rusby* (US); Flagstaff, Aug., 1884, *M. E. Jones 3947* (NY, RM, US); San Francisco Mountains, 2 Sept., 1889, *F. H. Knowlton 174* (US); Flagstaff, June, 1892, *J. W. Toumey 573* (US); Grand Canyon, July, 1892, *J. W. Toumey 575* (G, US); Grand Canyon, July, 1892, *E. O. Wooton* (US); Flagstaff, Sept., 1895, *J. W. Toumey* (NY, UC); Flagstaff, July, 1897, *C. L. Harris 913* (US); Flagstaff, 1900, *C. A. Purpus 8083* (US); Flagstaff, June, 1901, *J. B. Leiberg 5522* (US); Flagstaff to Mugillo Mountains, July, 1903, *D. Griffiths 4974* (US); Coconino Forest, Aug., 1908, *G. A. Pearson 11* (US); Grand Canyon, July, 1912, *V. Rattan* (UC); Grand Canyon, June, 1913, *A. E. Hitchcock 39* (US); Flagstaff, Aug., 1915, *A. S. Hitchcock* (US); Kaibab Forest, 1918, *Korstion & Baker 131* (FS). Navajo County: Taylor, June, 1897, *W. Hough 72* (US). Pima County: Sabina Canon, Catalina Mountains, Apr., 1892, *J. W. Toumey 572* (US 211833 in part). Yavapai County: Ashfork, July, 1903, *D. Griffiths 4873* (US). County not determined: Hell's Canyon, May, 1883, *H. H. Rusby 1402* (US); Hell's Canyon, June, 1883, *H. H. Rusby 552, 554* (UC); Nagles Ranch, 13 Sept., 1894, *M. E. Jones 6054g* (US).

7*b*. **Lupinus Kingii argillaceus** (Woot. & Standl.) comb. nov. [FIG. 45.]

Lupinus argillaceus Woot. & Standl. Contr. U. S. Nat. Herb. **16**: 137. 1913.

Differs from the typical form of the species in the pubescence being shorter and subappressed, especially that of the calyx and pedicels being appressed and inconspicuous. No other characters seem to separate this from the widely branching individuals of the obviously villous species.

NEW MEXICO. San Miguel County: near Pecos, Aug., 1908, *P. C. Standley 4974, 4975* (NY, US). McKinley County: Rio Zuni, July, 1892, *E. O. Wooton* (US 735190 and 562216).

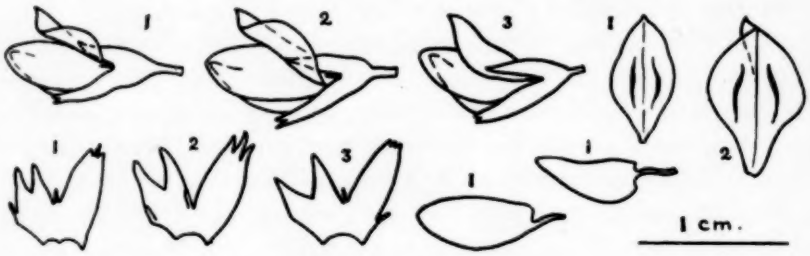


FIG. 45. LUPINUS KINGII ARGILLACEUS (Woot. & Standl.) C. P. Smith. 1. *P. C. Standley 4975* (US); 2. *E. O. Wooton* (US 562216); 3. *J. Wolf 195* (US).

COLORADO. Mesa County: Loma, Rio Grande, Sept., 1873, *J. Wolf 195* (US).

8. LUPINUS BREVICAULIS Wats. Bot. King's Report 53. 1871. [FIG. 46.]

Lupinus dispersus Heller, Muhlenbergia **5**: 141. 1909.

Lupinus scaposus Rydberg, Bull. Torrey Club **34**: 45. 1907.

Low, less than 1 dm. tall, densely villous, stems short, seldom over 1 cm. long; leaves crowded basally, glabrous above: peduncles 3–6 mm. long, the subcapitate racemes about 2 mm. long, commonly elongating after anthesis; flowers 6–8 mm. long, crowded; pedicels 1–2 mm. long, villous; calyx bracteolate, villous, upper lip 1–2 mm. long, truncate, two-lobed or bifid, lower lip 4–6 mm. long, two- to three-toothed, or rarely entire; petals bright blue or pale-tinted, banner about 6 mm. long, 2–4 mm. wide, apex angled or rounded, wings 4–6 mm. long, 2 mm. wide, keel 4–6 mm. long, straight; pods ovate, about 10 mm. long, ovules two or three, seeds 2 mm. long.

From the first I experienced difficulty in attempting to follow others in separating *L. brevicaulis* and *L. dispersus*. Careful attention to the original descriptions shows few differences brought out, except as to the calyx-lips.

Quoting from Watson:

> . . . upper lip very short, truncate, obsoletely toothed, membranous, lower entire or obscurely toothed. . . .

Quoting from Heller's description of his species:

. . . upper calyx lobe less than 2 mm. long, 2-parted almost to the base, the divisions with a broad somewhat U-shaped sinus; lower lobe nearly 4 mm. long, prominently 2-toothed, the sinus narrow. . . .

I have dissected flowers and made drawings from fourteen of the numerous collections examined and here listed. As shown in FIG. 44, both the lower and upper calyx-lips exhibit considerable

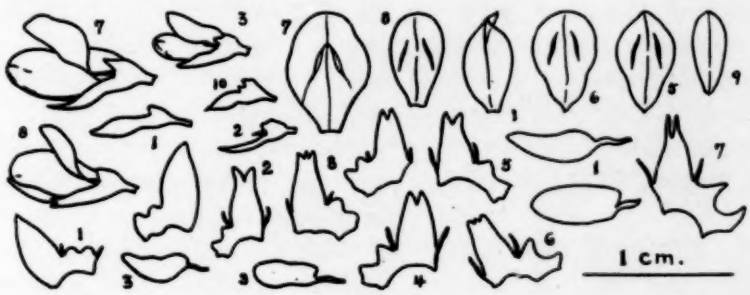


FIG. 46. LUPINUS BREVICAULIS Wats. 1. *A. A. Heller 8646* (US); 2. *M. E. Jones 3814* (US); 3. *Mrs. J. Clemens* (CPS); 4. *M. E. Jones 5273* (US); 5. *M. E. Jones 5130y* (US); 6. *M. E. Jones 5272b* (US); 7. *D. Griffiths 3935* (US); 8. *E. O. Wooton* (US 737532); 9. *C. F. Baker 437* (US); 10. *J. B. Leiberg 2198* (US).

variation. The lower lip is entire in only one of these fourteen cases, i.e. Heller's Reno collection. Five cases show a three-toothed lower lip, four cases the two-toothed condition, and two collections show both two-toothed and three-toothed individual calyces.

Rydberg's *L. scaposus* is evidently a pathological phase of *L. brevicaulis*. I have examined the type collection (T, G, RM) and cannot find justification for recognizing this form even as a variety. Three other collections, from as many states, include specimens of this variation. These are: "Jones 5273, Kanab, Ut." (RM 14246); "Lemmon, Camp Lowell, Ari." (G); and "Watson 223, Coyote Mts., Nev." (T). We should not overlook Watson's own record (1871, p. 53) which reads:

A form of this was collected with some of the peduncles much elongated and bearing above the leaves loose racemes of reduced florets, apparently perfect in all their parts, but usually sterile (223).

I see only the one species in this series of specimens. If the extremes of western Nevada were alone before me, I could readily accept Heller's segregate as a variety of Watson's species; but

careful study of all the material considered shows no sufficiently constant or fundamental differences available for a satisfactory varietal classification.

OREGON. Lake County: Chewaucan Marsh, 2 June, 1911, *W. W. Eggleston 6771* (US); Fifteen Mile Creek, Warner Valley, 16 June, 1911, *W. W. Eggleston 6983* (US). Harney County: base of Steins Mountain, 30 May, 1885, *T. Howell* (US, G). Malheur County: Barren Valley, 1885, *W. Cusick 1250* (US); Dry Creek hills, June, 1901, *W. Cusick 2554* (US, G, NY, UC, RM); Barren Valley, June, 1896, *J. B. Leiberg 2198* (US, G, UC).

NEVADA. Humboldt County: Coyote Mountains, June, 1868, *S. Watson 223* (US 41363, T); Humboldt Valley, 1868, *S. Watson 222* (T). Washoe County: Reno hills, June, 1900, *S. G. Stokes* (NY); Truckee Pass, June, 1906, *P. B. Kennedy 1333* (US, NY); Truckee Pass, June, 1907, *A. A. Heller 8646* (US, B); Reno, 1 May, 1910, *A. A. Heller 10006* (US, B, NY, RM). Mineral County: Hawthorne, June, 1882, *M. E. Jones 3814* (US, NY). Esmeralda County: Candalaria, *W. H. Shockley 51* (UC). Nye County: Tonopah, June, 1907, *W. H. Shockley 86* (UC); Rhyolite, June, 1907, *W. H. Shockley 54* (UC). Lincoln County: Caliente, May, 1902, *L. N. Goodding 942* (RM).

UTAH. Weber County: Ogden, June, 1903, *S. G. Stokes* (US). Davis County: Antelope Island, June, 1869, *S. Watson 222* (US). Salt Lake County: near Garfield, May, 1909, *Mrs. J. Clemens* (US, NY, RM, CPS). Juab County: Diamond Valley, 28 Apr., 1894, *M. E. Jones 5125c* (US). Piute County: Marysvale, May, 1894, *M. E. Jones 5338i* (US). Washington County: La Verken, May, 1894, *M. E. Jones 5183b* (US); Silver Reef, May, 1894, *M. E. Jones 5149g, 5151* (US); Santa Clara Valley, Apr., 1894, *M. E. Jones 5139h, 5139y* (US); Spring Dale, May, 1894, *M. E. Jones 5261h* (US). Kane County: Kanab, May, 1894, *M. E. Jones 5273* (US, NY, UC, RM).

COLORADO. Garfield County: Glenwood Springs, June, 1899, *G. E. Osterhout* (T, G, RM). Delta County: Surface Creek, March, 1892, *C. A. Purpus 175* (UC); Hotchkiss, June, 1802, *J. H. Cowen 147* (NY, G); same, *J. H. Cowen 648* (CAC); Delta, June, 1909, *L. Tidestrom 2198* (US). Montrose County: Naturita, May, 1914, *E. Payson 306* (NY, RM). La Plata County: Dur-

ango, June, 1898, *C. S. Crandall* (RM). Archuleta County: Arboles, June, 1899, *C. F. Baker 437* (US, G, NY, UC, RM).

NEW MEXICO. McKinley County: Fort Wingate, 1883, *W. Mathews* (G). Socorro County: Patterson, June, 1892, *E. O. Wooton* (US 241178, US 737533). Dona Ana County: plains at base of Organ Mountains, 1852, *C. Wright 1362* (US 20950–2); Filmore Canyon, Organ Mountains, May, 1905, *E. O. Wooton* (US). Grant County: Copper Mines, June, 1851, *Mex. Bound. Survey 287* (NY); River Mimbres, May, 1851, *G. Thurber 335* (T); Silver City, 1891, *G. C. Nealley 39* (NY); same, *G. C. Nealley 40* (US); Silver City, May, 1906, *V. Bailey* (US). County not given: without definite locality, 1869, *E. Palmer* (US 20576, T): Mesa Top, 1883, *C. D. Walcott 28* (US).

CHIHUAHUA. Ojo de Vacate, June, 1851, *G. Thurber 335* (NY).

ARIZONA. Cochise County: Camp Lowell, 1880, *J. G. Lemmon* (G). Santa Cruz County: Tumacacori and vicinity, 1903, *D. Griffith 3955* (US). Pima County: Canaca to Arivaca, 1903, *D. Griffith 3570* (US). Yavapai County: Ash Fork, May, 1903, *D. Griffith* (US). Coconino County: base of San Francisco Mountains, July, 1884, *J. G. Lemmon & wife* (US, UC); Hell's Canyon, May, 1883, *H. H. Rusby 554* (US, T); Turkey Tanks, Flagstaff, June, 1891, *D. T. McDougal* (US); Pipe Spring, May, 1894, *M. E. Jones 5272b* (US). Mohave County: Hackberry, May, 1884, *M. E. Jones* (US 220209); near Kingman, June, 1893, *N. C. Wilson* (UC).

CALIFORNIA. San Bernardino County: New York Mountains, near Leastalls, June, 1915, *S. B. Parish 10259* (UC). Inyo County: Bishop Creek, May, 1886, *W. H. Shockley 424* (UC).

9. LUPINUS SHOCKLEYI Wats. Proc. Am. Acad. **22**: 470. 1887. [FIG. 47.]

More or less acaulescent, 1–2 dm. tall, densely pubescent with hairs about 1 mm. long, spreading on the stems and petioles, sub-appressed on the leaves; peduncles 5–10 cm. long, racemes lax, 3–6 cm. long, equalled or surpassed by the foliage; flowers about 6 mm. long; pedicels slender, often curved, about half as long as the flowers, spreading-pubescent; calyx hairy, the upper lip 3 mm. long, bifid, lower lip 3–4 mm. long, minutely three-toothed or

sometimes bifid; petals "blue or purple" or pink, banner 5–6 mm. long, 4 mm. wide, angled at apex, wings 5 × 3 mm., keel straight, 4 mm. long, 2 mm. wide: pods "oblong ovate," ciliate on the margins, scaly on the sides, ovules two, seeds rough, about 3 mm. in diameter, pale in color.

ARIZONA. Mohave County: Kingman, May 1884. *J. G, Lemmon & wife* (UC).

NEVADA. Esmeralda County: Sodaville, *W. H. Shockley 367* (T, UC); same locality, June, 1888, *W. H. Shockley 4359* (NY). Mineral County: Hawthorn, June, 1882, *M. E. Jones 3812* (NY, RM, US).

CALIFORNIA. Kern County: Tehachapi, June, 1884, *K. Brandegee* (UC). Riverside County: Palm Springs, Apr., 1905, *H. M. Hall 5762* (UC); Point of Rocks, Whitewater, Apr., 1911,

FIG. 47. LUPINUS SHOCKLEYI Wats. 1. *M. E. Jones 3812* (US); 2. *J. G. Cooper* (US 344389).

E. E. Schellenger (UC). San Bernardino County: Camp Cady, Mojave River, June, 1861, *J. G. Cooper* (US); Browns Ranch, Mojave Desert, May, 1882, *S. B. Parish* (UC); Morongo, Colorado Desert, March, 1882, *S. B. Parish 1270* (NY; from the herbarium of H. E. Hasse); Mojave River, *E. Palmer* (NY; from the herbarium of P. V. Le Roy); Barstow, *K. Brandegee* (UC); Daggert, May, 1917, *K. Brandegee* (UC); Kelso, May, 1917, *K. Brandegee* (UC); Colorado Desert, Apr., 1905, *T. S. Brandegee* (UC). San Diego County: Borregos Spring, *T. S. Brandegee* (UC).

The New York sheet from Dr. Hasse's herbarium (*S. B. Parish 1270*) includes two specimens of *L. Shockleyi* and one specimen each of *L. odoratus, L. concinnus*, and *L. microcarpus* var. *ruber*. Mr. Parish informs me that his No. 1270 belongs to a collection of *L. odoratus* taken in May, 1882, while his visit to the Morongo was in April of that year. It seems evident, therefore, that this label cannot be accepted as correctly applying to any of the

specimens assembled on the sheet. The boundary line separating Riverside and San Bernardino Counties passes through the Morongo country and it seems to be impossible to determine on which side of the line were taken the Morongo specimens here referred to San Bernardino County.

Palmer's specimen from Le Roy's herbarium is a striking variation towards *L. odoratus* and probably should have been given more serious attention here.

10a. LUPINUS ODORATUS Heller, Muhlenbergia **2**: 71. 1905. [FIG. 48.]

Nearly or quite acaulescent, glabrous or sparsely villous, 1–2 dm. tall; peduncles commonly erect, equalling or exceeding the leaves, racemes 5–8 cm. long; flowers 10 mm. long, well-scattered; pedicels 4–6 mm. long, glabrous; calyx glabrous, upper lip about as broad as long, 2 mm. long, entire or notched, lower lip about 5 mm. long, entire or obscurely three-toothed; petals blue or purple, the banner with a yellow center, 10 mm. long and 10 mm. wide, wings 8 mm. long, 5–6 mm. wide, keel 7–8 mm. long, the point decidedly upturned; pods oblong, 17–20 mm. long, smooth or scaly on the sides, villous on the margins, ovules two to six, seeds rough, about 3 mm. across, unmarked (?).

FIG. 48. LUPINUS ODORATUS Heller. 1. *S. B. Parish 4957* (US); 2. *A. E. D. Elmer 3624* (US); 3. *A. A. Heller 8207* (CPS).

This excellent species is of special interest both because of its number of ovules and its limited supply of hair-covering. The former character suggests relationship to certain species of the annuals of the subgenus *Lupinus*; but its cotyledons are sessile and its relationship is evidently closer to *L. pusillus*. There should be no further excuse for confusing it with *L. brevicaulis*.

CALIFORNIA. Los Angeles County: Dry Lake, Antelope Valley, May, 1896, *J. B. Davy 2223* (UC); Lancaster, June, 1902,

A. E. D. Elmer 3624 (B, G, NY, US); Lancaster, May, 1909, *K. Brandegee* (UC). Kern County: Antelope Valley, May, 1905, *F. Grinnell* (US); North Fork Kern River, June, 1888, *E. Palmer 112* (US); Green Horn Mountains, June, 1888, *E. Palmer 112* (T); near Randsburg, May, 1906, *H. M. Hall & H. P. Chandler 7285* (UC); Randsburg, May, 1913, *K. Brandegee* (UC). San Bernardino County: Fort Mojave, *J. G. Cooper* (US); Cajon Pass, east slope, June, 1861, *J. C. Cooper* (US); Mojave River, June, 1876, *E. Palmer 84* (G); Mojave Desert borders, May, 1882, *S. B. & W. F. Parish 96* (T), *1269* (G); Mojave Desert, May, 1899, *C. J. Pringle* (G, US); Hesperia, June, 1901, *S. B. Parish 4957* (NY, US); same locality, May, 1892, *S. B. Parish 2354* (T); same locality, June, 1895, *S. B. Parish 3774* (G, UC); Mojave, Apr., 1905, *Mrs. C. DeKalb* (NY); Barstow, May, 1905, *H. M. Hall 6166* (B, UC); five miles west of Barstow, March, 1914, *Mable Minthorn* (UC); Kramer, Apr., 1905, *A. A. Heller 7673* (B, NY, UC); same locality, May, 1909, *K. Brandegee* (RM, UC); same locality, 1919, *K. Brandegee* (UC); Blacks Ranch, near Fremont Peak, May, 1906, *Hall & Chandler 6843* (B, G, UC); Deadman's Point, Apr., 1916, *S. B. Parish 10787* (UC). Inyo County: near Olancha, Apr., *T. S. Brandegee* (UC); Owens Lake, Apr., 1900, *S. W. Austin 22* (NY); Laws, May, 1906, *A. A. Heller 8207* (B, G, NY, UC); Big Pine, June, 1906, *Hall & Chandler 7285* (RM, UC).

NEVADA. County not given: Great Basin, 1875, *J. G. Lemmon* (US 20973). Washoe County: without definite locality, May, 1875, *J. G. Lemmon* (G).

ARIZONA. Mohave County: near Kingman, June, 1884, *J. G. Lemmon* (G); Hackberry, May, 1884, *M. E. Jones 66* (G).

10*b*. **Lupinus odoratus pilosellus** var. nov.

A *L. odorati* differt caulibus petiolisque conspicue pilosis: leguminibus oblongis, 2 cm. longis; seminibus 2–4.

Stems and petioles conspicuously pilose with short white spreading hairs; pods oblong, 2 cm. long, two- to four-seeded.

CALIFORNIA. San Bernardino County: Nipton, June, 1905, *K. Brandegee* (Type, UC 180117); Mohave River, May, 1876, *E. Palmer 84* (UC 82240).

11a. LUPINUS RUBENS Rydberg, Bull. Torrey Club **34**: 45. 1907. [FIG. 49.]

Branched at or near the base, 6–15 cm. tall, villous, axial peduncle usually erect, commonly flowering before the branches develope, racemes exceeding the foliage; flowers 6–12 mm. long, approximate or well scattered; pedicels 1–2 mm. long, usually glabrous but sometimes more or less villous; calyx-lips setose-villous, the cup commonly free of hairs, upper lip entire or notched, lower lip entire or two- or three-toothed; petals as in *L. odoratus*, the banner with a yellow center; pods ovate, 8–12 mm. long, usually two-seeded, more or less villous on the sides; seed characters yet to be determined.

This is a variable species intermediate between *L. pusillus* and *L. odoratus*. One extreme, when in flower, is hardly separable from the New Mexican variation of *L. pusillus*, while other forms approach closely to *L. odoratus*. Critical cases will evidently have to be judged in terms of fruiting material.

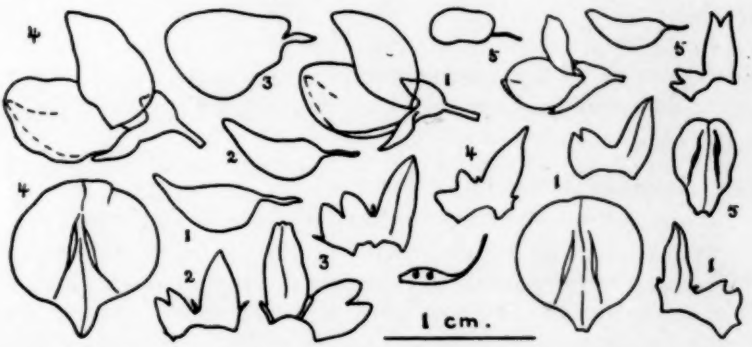


FIG. 49. LUPINUS RUBENS Rydberg. 1. *M. E. Jones 5138* (US); 2. *M. E. Jones 4413* (US); 3. *M. E. Jones 5024i* (US); 4. *E. D. Ball* (CPS); 5. *J. G. Cooper* (US 344379).

UTAH. Emery County: Green River, May, 1890, *M. E. Jones* (US); same locality, May, 1909, *E. D. Ball* (CPS). Grand County: Grand River Canyon below Moab, July, 1911, collector not given (NY). Kane County: Kanab, *Mrs. A. P. Thompson* (G). Washington County: St. George, Apr., 1880, *M. E. Jones 1657* (NY, RM, T, US); same locality, Apr., 1884, *M. E. Jones 5110j* (US); Santa Clara Valley, Apr., 1884, *M. E. Jones 5138* (NY, UC, US). County not ascertained: southern Utah, 1872,

Capt. Bishop (US), 1873, *Capt. Bishop* (G), 1874, *C. C. Parry 4, 42* (T).

ARIZONA. Navajo County: six miles northeast of Winslow, May, 1901, *L. F. Ward* (US). Coconino County: ten miles north of Tuba, May, 1901, *L. F. Ward* (US). Mohave County: Hackberry, May, 1884, *M. E. Jones 4413* (US). County not determined: no locality, 1869, *E. Palmer* (US 20944, two upper specimens); Beaverdam, Apr., 1894, *M. E. Jones 5024i* (US).

NEVADA. Clark County: Cottonwood Springs, Vegas Valley, 1891, *V. Bailey 1876* (US). Lincoln County: Caliente, Meadow Valley Wash, May, 1902, *L. N. Goodding 942* (RM). County not given: Dry Lake, Apr., 1905, *L. N. Goodding 2234a* (G, NY, RM, UC).

CALIFORNIA. Inyo County: Wild Rose Springs, Panamint Mountains, May, 1915, *S. B. Parish* (UC). San Bernardino County: Cajon Pass, 1860–1861, *J. G. Cooper* (RM, left-hand specimen); Providence Mountains, near summit, May, 1861, *J. G. Cooper* (US); New York Mountains, June, 1915, *S. B. Parish 10073* (UC); Good Springs, May, 1915, *K. Brandegee* (UC); Cima Station, May, 1915, *K. Brandegee* (UC 180152, upper specimen).

11*b*. **Lupinus rubens flavoculatus** (Heller) comb. nov. [FIG. 50.]

Lupinus flavoculatus Heller, Muhlenbergia **5**: 149. 1909.

Differs from *L. rubens* proper in the early development of floriferous, widely spreading branches, in the longer pedicels (1–4 mm.), and in the lower calyx-lip being usually two-toothed.

This much resembles various specimens of *L. odoratus*, but seems to be fairly constant in its differences as to pubescence and fruit. It varies easily into that variable species, and my disposition of some of the specimens cited here is not beyond fair questioning. One of the specimens (UC 149911) is evidently a pathological variation.

NEVADA. Nye County: Rhyolite, May, 1907, *W. H. Shockley 43* (UC); Rhyolite, May, 1909, *A. A. Heller 9669* (B, NY, RM, UC, CPS).

CALIFORNIA. Inyo County: Darwin Mesa, Yucca Valley, May, 1891, *F. V. Coville & F. Funston 877* (US); Boundary Canyon, Grapevine Mountains, June, 1891, *F. V. Coville & F. Funston 977* (G, T, US); Lone Pine, May, 1913, *K. Brandegee* (UC).

San Bernardino County: Barnwell, May, 1911, *K. Brandegee* (UC 149898, 149909–10–11); Cima Station, May, 1915, and

FIG. 50. LUPINUS RUBENS FLAVOCULATUS (Heller) C. P. Smith. *A. A. Heller 9669* (CPS).

June, 1915, *K. Brandegee* (UC). Kern County: South Fork Kern River, 1898, *C. A. Purpus 5714* (UC, US). Modoc County: Surprise Valley, May, 1879, *J. G. Lemmon* (G).

12*a*. LUPINUS PUSILLUS Pursh, Fl. Am. Sept. **2**: 468. 1814. [FIG. 51.]

Stems well-developed, branches ascending to widely-spreading, loosely villous, 1–2 dm. tall; peduncles 1–2 cm. long, racemes 3–5 cm. long, mainly equalled or exceeded by the leaves; flowers 10–12 mm. long, well scattered; pedicels about 2 mm. long, villous; calyx villous, upper lip broader than long, 2 mm. long, the short teeth acute or rounded, lower lip over twice as long as wide, 5–6 mm. long, the apex entire and acuminate, acute, or rounded, or occasionally three-toothed; petals bluish, purplish, or almost

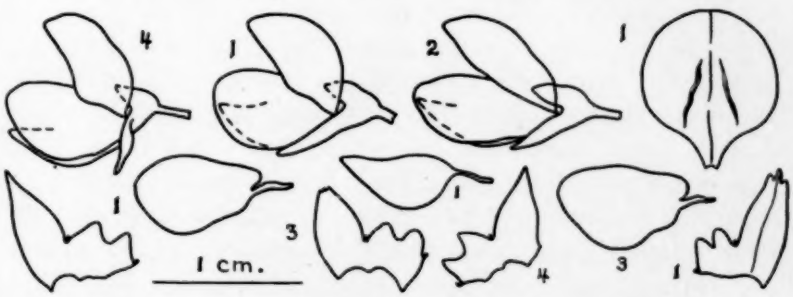


FIG. 51. LUPINUS PUSILLUS Pursh. 1. *V. Bailey 10* (US); 2. *M. E. Moodie 946* (US); 3. *A. Nelson 8258* (US); 4. *E. Palmer 82* (US 291129).

white, banner 10–11 mm. long and 9–10 mm. wide, wings 8–9 mm. long, 5–6 mm. wide, keel 8 mm. long, 3.5 mm. wide, the point somewhat upturned; pods 20–25 mm. long, lance-oblong, acute at the apex, slightly constricted near the middle, two-seeded; seeds about 4 mm. across, rugose, apparently unmarked.

The typical form of this species is mainly confined to the Atlantic drainage of the Rocky Mountain region, the exception being its occurrence on the "Snake Plains" of southern Idaho. The New Mexican plants referred here may prove to be a separable variety, as the racemes often exceed the foliage and the plants suggest the larger phases of *L. rubens*. Fruiting material, with matured seeds, is much desired from New Mexican localities and Green River, Utah. The Great Basin form, separated by Heller, deserves recognition as a variety, some intermediates occurring.

ALBERTA. Bow Valley County: West Fork Water Coulee, near Rosedale, June, 1915, *M. E. Moodie 946* (G, US). Medicine Hat County: Medicine Hat, May, 1894, *J. Macoun 4069* (G).

ALBERTA or SASKATCHEWAN. West of South Saskatchewan, June, 1879, *J. Macoun 104* (G); north of Cypress Hills, Aug., 1880, *J. Macoun* (T); Cypress Hill, July, 1895, *J. Macoun 10412* (G).

IDAHO. Elmore County: King Hill, July, 1911, *Nelson & McBride 1111* (RM). Ouyhee County: Murphy, July, 1911, *Nelson & McBride 1030* (RM). Bingham County: Blackfoot, July, 1893, *E. Palmer 275* (US). Lincoln County: Bluelakes, June, 1893 *E. Palmer 82* (US).

MONTANA. Cascade County: Great Falls, July, 1885, *R. S. Williams 214* (US); Great Falls, Sept., 1886, *F. W. Anderson* (UC); Falls of the Missouri, July, 1887, *F. W. Anderson 1422* (NY). Dawson County: near Glendive, 1883, *L. F. Ward* (US); Glendive, June, 1908, *B. T. Butler 2005, 2006* (NY). Still Water County: Still Water, July, 1889, *F. Tweedy 3* (NY). Custer County: Miles City, June, 1893, *F. E. Lloyd* (NY). Yellowstone County: Custer, May, 1890, *J. W. Blankinship* (UC). Park County: Upper Yellowstone, July, 1899, *J. W. Blankinship* (G, RM). Locality not given: 1890, *P. A. Rydberg 397* (NY); June, 1890, *J. W. Blankinship 156* (US).

YELLOWSTONE PARK. Yellowstone, *V. Havard* (US); eleven miles above Glendive, July, 1883, *L. F. Ward* (US); mouth of Gardiner River, *F. Tweedy* (US).

WYOMING. Albany County: Laramie River, Laramie Peak, 1864, *R. B. Hetz* (US). Converse County: Lost Springs, July, 1915, *W. L. Hees 113* (RM). Crook County: Pine Ridge, July,

1909, *M. Cary 365* (US). Diobrara County: Van Tassell, Douglas, June, 1899, *H. M. Barrow 35* (RM). Johnson County: Buffalo, 23 July and 26 July, 1898, *T. A. Williams* (US). Laramie County: Fairbanks, July, 1894, *A. Nelson 490* (G, RM, T, UC, US). Natrona County: Alcova, July, 1901, *L. N. Goodding 157* (RM). Platte County: Wheatland, June, 1901, *A. Nelson 8258* (B, G, NY, RM, UC, US). Washakie County: Worland, June, 1909, *B. C. Buffum* (RM). County not given: 1893, *B. W. Evermann* (US); four miles below U. L. Ranch, July, 1896, *F. H. Knowlton 159* (US); Sweetwater River, July, 1898, *E. Nelson 4989* (CAC, RM); Cheyenne River, *E. J. Wallace* (RM).

COLORADO. Denver County: Denver, May, 1873, *J. M. Coulter* (US); Denver, June, 1873, *J. Wolf 20* (US); Denver, Platte River, June, 1878, *M. E. Jones 199* (NY); Denver, July, 1885, *G. W. Letterman* (US). Fremont County: Canon City, 1872–1873, *T. S. Brandegee* (UC). Larimer County: LaPorte, June, 1895, *J. H. Cowen 149* (G, NY); Ft. Collins, *W. F. Marshall 734* (CAC, RM, US); Fort Collins, June, 1898, *C. S. Crandall* (RM); Fort Collins, June 1915, *J. H. Cowen 113* (US), same, June, 1893 (G). Lincoln County: Hugo, July, 1905, *C. D. Marsh* (US). Ouray County: Ridgeway, Aug., 1894, *F. Tweedy 240* (US); Uray [Ouray], May, 1900, *J. E. Payne* (CAC). Prowers County: Lamar, May, 1892, *C. S. Crandall* (CAC). Pueblo County: Pueblo, June, 1891, *E. Penard* (T): Pueblo, June, 1897, collector not given (CAC); Pueblo mesas, May, 1900, *P. A. Rydberg & F. V. Vreeland 5941* (NY, RM). Weld County: Crow Creek, June, 1896, *F. H. Knowlton 97* (NY, US); New Windsor, June, 1895 and 1901, *G. E. Osterhout* (NY); same locality, June, 1905, *G. E. Osterhout* (G, RM). County not given: June, 1970, *E. L. Greene 67* (G); June, 1890, *C. H. Hall* (B).

NORTH DAKOTA. Barnes County: Valley City, Cheyenne Valley, July, 1903, *M. A. Barber 176* (G). Billings County: Marmarth, July, 1909, *V. Bailey 10* (US). Morton County: Parkin, June, 1916, *V. Bailey* (US). County not given: Bad Lands, July, 1891, *H. L. Bolley 132* (RM).

SOUTH DAKOTA. Fall River County: without definite locality, Aug., 1911, *S. S. Visher 2703* (RM); Fall River Falls, June, 1892,

P. A. Rydberg 599 (US). Harling County: Steppe, July, 1910, *S. S. Visher 231* (RM). Meade County: Smithville, June, 1894, *V. Bailey 10* (US). Perkins County: Bixby, July, 1912, *S. S. Visher 615* (RM). Washington County: Sheep Mountain and sand hills south, July, 1911, *S. S. Visher 2406* (NY). County not given: near White Earth River, Missouri, *J. N. Nicolet 161* (G); north edge of sand bluff, *S. A. Skinner 177* (RM).

NEBRASKA. Brown County: Longpine, June, 1897, *J. M. Bates* (RM). Cherry County: Valentine, June, 1891, *J. M. Bates* (G, T). Frontier County: near Curtis, June, 1891, *P. A. Rydberg 46* (NY). Keith County: without definite locality, June, 1890, *G. D. Swezey* (T). Dawes County: Crawford, June, 1891, *J. M. Bates* (B).

KANSAS. Finney County: Garden City, May, 1891, *H. W. Menke* (T). Graham County: without definite locality, June, 1897, *A. S. Hitchcock 81a* (G, NY, RM, US). Logan County: without definite locality, May, 1895, *A. S. Hitchcock 81* (G, NY, RM, US). County not given: western Kansas, 1885, *E. N. Plank 25* (G).

NEW MEXICO. San Juan County: Aztec, May, 1899, *C. F. Baker 435* (G, NY, RM,* US). Dona Ana County: near Organ Mountains, Apr., 1852, *Mexican Boundary Survey 287* (NY, two sheets); opposite Frontera, March, 1852, *C. Wright 1362* (US 20950–1). Without locality: *Mex. Boundary Survey* (US 20941, upper and left-hand specimens); 1851, *C. Wright 1362c* (G); May, 1901, *F. K. Vreeland 821* (NY).

ARIZONA. Pima County: Tucson, March, 1852, *C. C. Parry* (T). Without locality: 1869, *E. Palmer* (US 20944, two upper specimens).

12b. **Lupinus pusillus intermontanus** (Heller) comb. nov. [FIG. 52.]

Lupinus intermontanus Heller, Muhlenbergia **8**: 87. 1912.

* The "RM" sheet of this collection has Baker's number given as "433," and is labelled *L. aduncus* Greene, whence Heller has annotated this sheet as follows: "Apparently immature *L. rubens* Rydb. Baker has mixed labels. *L. aduncus* is a perennial. I have the real thing here now, also under 433." It is evidently a part of Baker's collection 435, which seems to have been originally determined as *L. arizonicus*. I may be wrong in assigning it to *L. pusillus* instead of to *L. rubens*. Matured plants with pods and seeds are needed for additional study.

Plants usually more congested than in the species; flowers appreciably smaller, 7–9 mm. long; pedicels and calyx-cup glabrous or sub-villous, lips villous, lower lip less than twice as long as broad, 3–4 mm. long, entire or three-toothed at apex; banner 7–8 mm. long, 5–6 mm. wide, wings about 3 × 6 mm., keel 6 mm. long, straight or the acumen slightly upturned.

CALIFORNIA. Modoc County: Surprise Valley, May, 1879, *J. G. Lemmon* (G). Inyo County: Deep Spring Valley, 1898, *C. A. Purpus 5807* (UC, US).

NEVADA. Clark County: Jean, May, 1915, *K. Brandegee* (UC). Esmeralda County: Candelaria, *W. H. Shockley 270* (UC). Humboldt County: Unionville, June, 1868, *S. Watson 221* in part (US). Ormsby County: Carson City 1864, *C. L. Anderson 84*

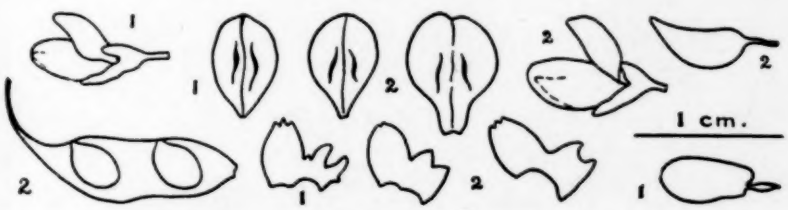


FIG. 52. LUPINUS PUSILLUS INTERMONTANUS (Heller) C. P. Smith. 1. *A. A. Heller 9509* (CPS); 2. *Merrill & Wilcox 725* (US).

(G); Empire City, June, 1882, *M. E. Jones 3813* (NY, US). Washoe County: Wadsworth, May, 1909, *A. A. Heller 9599* (B, G, RM, UC, US, CPS); same locality, June, 1913, *K. Brandegee* (UC).

OREGON. Harney County: Alvord Desert, June, 1896, *J. B. Leiberg 2432* (US); same locality, July, 1898, *W. C. Cusick 2020* (G, RM, UC, US). Lake County: Drews Valley, July, 1893, *Mrs. R. M. Austin* (UC).

WASHINGTON. Franklin County: Pasco, June, 1892, *L. F. Henderson 2362* (G); same locality, May, 1899, *C. V. Piper 2982* (G. NY). Walla Walla County: Wallula, May, 1883, *T. S. Brandegee 706* (G); same locality, May, 1896, *T. Howell 1920* (NY); same locality, May, 1903, *J. S. Cotton 1028* (US); Walla Walla, *Capt. Wilkes 955* (US 21026, right-hand specimen only*); same locality, May, 1903, *J. S. Cotton 1028* (G); plains of the Columbia River,

* The left-hand specimen is *L. subvexus fluviatilis*, in fruit.

1826 *ex Herb. Benth.* (G). Yakima County: Yakima River near Morgan's Ferry, June, 1884, *W. N. Suksdorf 269* (G); west of Mabton, June, 1903, *J. S. Cotton 1115* (US).

IDAHO. Owyhee County: Murphy, July, 1911, *Nelson & McBride 1030* (RM). Twin Falls County: Twin & Shoshone Falls, July, 1911, *Nelson & McBride 1333* (RM).

WYOMING. Big Horn County: Greybull, May, 1910, *M. Cary 521* (US). ? Sweet Water County: thirty-five miles north of Point of Rocks, June, 1901, *E. D. Merrill & E. N. Wilcox 611* (G, US); near Washington Ranch, June, 1901, *Merrill & Wilcox 725* (G, RM, US).

UTAH. Weber County: Ogden, 1872, *Hayden Survey* (US). Beaver County: Frisco, June, 1880, *M. E. Jones* (US). Kane County: Kanab, May, 1894, *M. E. Jones 5286f* (NY, UC, US); twenty miles south of Pahria, May, 1894, *M. E. Jones 5292c* (US).

ARIZONA. Coconino County: Moqui, May, 1869, *E. Palmer* (G).

COLORADO. Huerfano County: Walsenburg, July, 1896, *C. L. Shear 4753, 4800* (NY).

It is interesting to note that this small-flowered variety is almost entirely confined to the Pacific and Great Basin drainage.

Grass rusts of unusual structure*

J. C. Arthur and E. B. Mains

(with two text figures)

The leaves of species of *Olyra* belonging to the tribe Paniceae and of species of bamboos are frequently much alike in form and physical characters, although systematists place the genera nearly at the extremes of the grass series. The resemblances are often so great that only an experienced agrostologist can feel sure of their identity when not accompanied by inflorescence. It is not surprising, therefore, that the rusts on these genera, as well as their hosts, should have been confused. Thus *Uredo Olyrae* P. Henn., described in 1904, to which true *Olyra* rusts have been referred, has recently been found to be on some species of the bamboo genus *Arundinaria*, and *Uredo ignava* Arth. on the genus *Bambos* has only recently been separated from material formerly placed with paniceous rusts.

Not only is there a curious resemblance between the leaves of these two groups of hosts, but also an equally interesting resemblance between some of the rusts that inhabit them. This was first noticed in the uredinia having delicate incurved paraphyses and spores that are more or less thin-walled and colorless. Later it was found that the presence or absence of these weakly differentiated paraphyses is not by itself an important diagnostic character, as the forms called *Uredo paspalicola* without paraphyses and *U. Stevensiana* with paraphyses have been shown to be only extremes of one species having all degrees of intergradation.

In the study of this sort of rusts it became more and more necessary to use a razor and make sections of the sori in order to be surer of their structure. In this manner the paniceous species, *Puccinia tubulosa*, *P. inclita*, and *P. imposita*, were segregated and gradually circumscribed from what had been lumped as *P. sub-*

* Reprints may be obtained by application to the Botanical Department, Purdue University Agricultural Experiment Station, Lafayette, Indiana, under whose auspices the studies here reported were carried out.

striata. Then the telia were found in *P. Chaseana* on a host belonging to a family preceding the Paniceae. The final triumph came in the discovery of telia with the much-studied form, *Uredo pallida* (*Puccinia pallescens*) on *Tripsacum*, a grass belonging to the tribe Maydeae. These telia would doubtless not have been discovered through the usual method of examination by scraping the spores from the leaf with a scalpel. Sections show the sori to be small, indehiscent, and filled with pale, compacted spores (FIG. 2*A*) that are thin-walled and practically without pedicels. Many of the teliospores are three-celled, especially toward the center of the sorus. The whole appearance of the telia and teliospores is quite unlike that of the ordinary grass rusts, and reminds one of those in the group of melampsoraceous rusts represented by *Phakopsora*.

Even with this experience the telia of still another species of rust on *Olyra latifolia* were passed over for a time. The uredinia had been referred to *Puccinia deformata* Berk. & Curt., on the same host, a species with prominent telia, known for over fifty years, but with no described uredinia.* Thin-walled, nearly colorless urediniospores, surrounded by incurved paraphyses, were found, and on the same leaves were discovered telia by the sectioning method. So unusual was the appearance of these telia, however, that they were tentatively referred to the genus *Phaksopsora*, and might have remained there longer had the grasses been known to harbor species of this genus. It was then thought there might have been an error in determination of the host, and that it was a bamboo, instead of the *Olyra*. After much study the following description of a new species of rust was evolved, and incidentally the true urediniospores of *P. deformata* were found.

Puccinia phakopsoroides sp. nov.

II. Uredina amphigenous, small, round, cinnamon-brown, early naked, ruptured epidermis inconspicuous; paraphyses peripheral, incurved, clavate, 10–12 by 35–50 μ, the wall cinnamon-brown, 1 μ thick, usually thickened up to 2–3 μ on the convex side; urediniospores ellipsoid or broadly obovoid, 19–26 by 27–35 μ; wall slightly brownish or nearly colorless, 1–1.5 μ thick, closely

* See Arthur & Johnston, Uredinales of Cuba. Mem. Torrey Club **17**: 136. 1918.

echinulate, the pores very indistinct, probably 2 and equatorial.

III. Telia hypophyllous, scattered, squarish-oblong, 0.5–1 mm. long, covered by the epidermis, compact with the spores adhering laterally, brownish-black due to discolored host-tissue; teliospores 1-, 2- or 3-celled, short-cylindric, 8–14 by 24–39 μ, rounded or depressed above and below, somewhat constricted at septa; wall pale-brown or colorless, smooth, thin, uniformly 1 μ or less in thickness, but with an outer colorless layer swelling in in water to 2–3 μ above, demonstrable by staining; pedicel wanting or extremely short and colorless.

On *Olyra latifolia* L., Mayagüez, Porto Rico, January 30, 1890, II, III, *A. A. Heller 4443*, communicated by P. L. Ricker; San German, Porto Rico, December 12, 1913, II, *F. L. Stevens 5849, 5855;* Manati, Porto Rico, July 2, 1915, II, *F. L. Stevens 7700;* Soledad, Cienfuegos, Cuba, November 7, 1915, ii, *J. R. Johnston 247;* Isle of Pines, Cuba, February 20, 1916, II, *Britton, Britton & Wilson 14648;* Ceballos, Cuba, March 24, 1916, II, *J. R. Johnston 509;* Guantanamo, Cuba, February 7, 1918, II, III, *J. R. Johnston 1028* (TYPE).

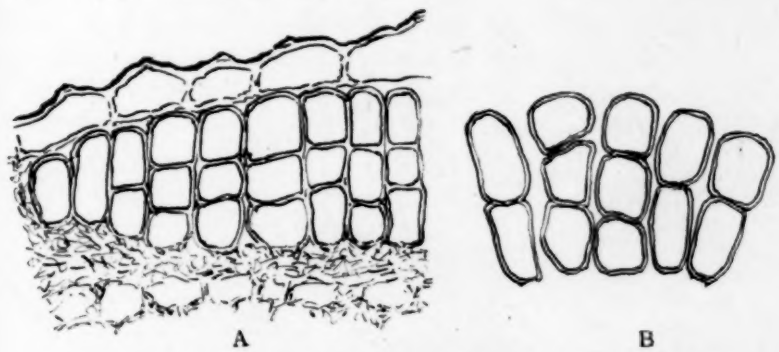


FIG. 1. *Puccinia phakopsoroides: A*, section showing part of a telial sorus and the adjoining host tissues; *B*, teliospores after treatment with potassic hydrate. × 625 diameters.

There is a marked gradation evident in some tropical rusts, especially the grass rusts as indicated above, toward the production of thin-walled, pale or colorless spores. In the uredinia these spores are frequently accompanied with a fringe of incurved, hyphoid paraphyses. In the telia the spores are small and often compacted, long remaining covered by the epidermis. As usual in subepidermal forms, these teliospores have short pedicels.

Puccinia phakopsoroides illustrates an extreme development in this general direction, most strongly seen in the telia. Drawings of the telial sorus of both *P. phakopsoroides* and *P. pallescens* (FIGS. 1*A*, 2*A*) show the spores as cylindrical bodies pressed very closely together, as if restricted by the unyielding epidermis. The spores appear to be less highly differentiated than in most grass rusts, having a variable number of cells with a quite uniform wall, and a pedicel so short and delicate that one is left in doubt whether there is a truly pedicellate cell, or only a hyphal connection with the hymenial layer of the fungus.

Sections of the sorus give a superficial resemblance to forms of *Phakopsora*, especially in the denseness, the pale color and translucency, and in the evenly disposed, vertical rows of apparently similar cells, more cells being in a row at the center of the sorus

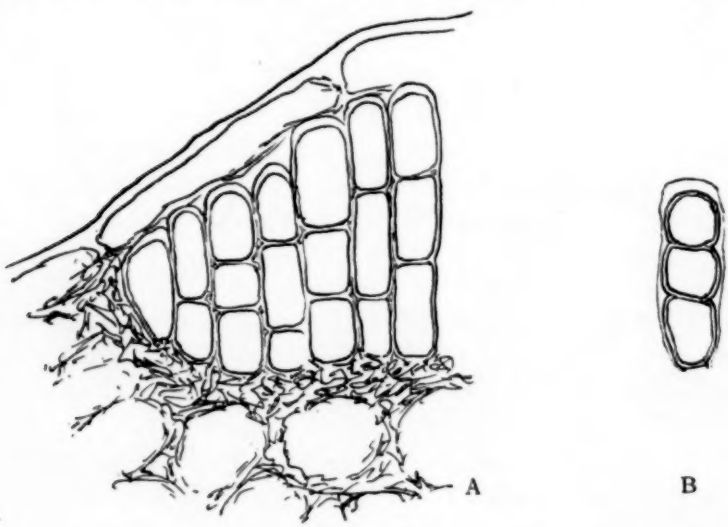


FIG. 2. *A*, section showing part of a telial sorus of *Puccinia pallescens*, with adjoining host tissues; *B*, a teliospore of *P. phakopsoroides* treated with eosin to show the outer hygroscopic layer of the spore-wall. × 625 diameters.

than at the edge. In *Puccinia* each row of cells forms a single spore; in *Phakopsora* there are as many independent spores as there are cells. In *P. phakopsoroides* this resemblance is emphasized when the sections are treated with potassic hydrate, and the spores pressed out of the sorus (FIG. 1*B*). The cells then seem

to separate and appear like one-celled spores in rows, the enveloping outer layer of the spore-wall being invisible, having been swollen and partly dissolved by the potash. However, if sections are stained with eosin, and the spores pressed apart, it is easy to discern a delicate outer layer of wall, swelling in water and becoming thicker above than at the sides of the spore (FIG. 2*B*). The presence of this hygroscopic layer explains why the cells remain in chains, even after macerating in potash, and doubtless why the cells adhere laterally with so much tenacity in an ordinary mount. In *P. pallescens* there is no such hygroscopic layer.

In the above paragraphs comparison has been drawn especially between three tropical rusts of similar but extreme development, which are found on grasses having slight relationship, according to the classification used by modern agrostologists: *Puccinia pallescens* on *Tripsacum*, the first genus in Hitchcock and Chase's "Grasses of the West Indies," *P. phaksopsoroides* on *Olyra*, the fifty-second genus in the same work and *Uredo ignava* on *Bambos*, the one hundred and tenth and last genus of that work. The telia of the last species have not yet been found, but it is confidently believed that when discovered they will resemble those of the other two species named.

PURDUE UNIVERSITY,
LAFAYETTE, INDIANA

INDEX TO AMERICAN BOTANICAL LITERATURE

1917-1919

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in the broadest sense.

Reviews, and papers that relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card issue should be addressed to the Treasurer of the Torrey Botanical Club.

Abrams, L. R A new California Cypress. Torreya **19**: 92. 9 Jl 1919.
Cupressus nevadensis sp. nov.

Arthur, J. C. A correction. Torreya **19**: 83. 25 Je 1919.
Syntherisma pruriens, error in publication.

Ashe, W. W. Notes on trees and shrubs in the vicinity of Washington. Bull. Torrey Club **46**: 221–226. 8 Jl 1919.
Amelanchier sera and *A. micropetala* (Robinson), spp. nov., are described.

Bailey, I. W. Structure development, and distribution of so-called rims or bars of Sanio. Bot. Gaz. **67**: 449–468. *pl. 13–15*. 21 Je 1919.

Barnhart, J. H. Brackenridge and his book on ferns. Jour. N. Y. Bot Gard. **20**: 117–124. Je 1919.

Benedict, R. C. The simplest fern in existence. Am. Fern Jour. **9**: 48–50. *pl. 3*. Jl 1919.

Bigelow, H. C. A fern from the battle-ground. Am. Fern Jour. **9**: 58. Jl 1919.

Bisby, G. R. Studies on *Fusarium* diseases of potatoes and truck crops in Minnesota. Minnesota Agr. Exp. Sta. Bull. 181: 1–47 *f. 1–30*. Mr 1919.

Blakeslee, A. F. A unifoliolate mutation in the Adzuki bean. Jour. Heredity **10**: 153–155. *f. 1, 2*. 26 My 1919.

Boynton, K. R. *Eupatorium coelestinum*. Addisonia **4**: 39, 40. *pl. 140*. 30 Je 1919.

Britton, N. L. & Rose, J. N. The Cactaceae. Descriptions and illustrations of plants of the Cactus family. i-vii + 1–236. *pl. 1–36* + *f. 1–301*. Washington. 1919.

Carnegie Publ. No. 248, Vol. I; includes the new genus *Tacinga* and new species in *Opuntia* (30), *Pereskia* (4), *Pterocactus* (3), *Nopalea* (1), and *Tacinga* (1).

Burt, E. A. *Merulius* in North America, supplementary notes. Ann. Missouri Bot. Gard. **6**: 143–145. Ap 1919.

Clark, H. W. Dwarf shore floras. Trans. Illinois Acad. Sci. **10**: 145–159, *pl. 1–5*. 1917.

Clayton, E. E. Hydrogen cyanide fumigation. Bot. Gaz. **67**: 483–500. *f. 1, 2*. 21 Je 1919.

Clute, W. W. Defining double flowers. Gard. Chron. Am. **23**: 189. Je 1919.

Cockerell, T. D. A. Sir Joseph Hooker. Science II. **49**: 525–530. 6 Je 1919.

Collins, G. N. A fossil ear of maize. Jour. Heredity **10**: 170–172. *f. 7*. 26 My 1919.

Coville, F. V. The threatened extinction of the box huckleberry, *Gaylussacia brachycera*. Science II. **50**: 30–34. 11 Jl 1919.

Dalbey, N. E. *Phyllachora* as the cause of a disease of corn, and a general consideration of the genus *Phyllachora*. Trans. Illinois Acad. Sci. **10**: 230–248. *f. 3–9*. 1917.

Duggar, B. M., & Davis, A. W. Seed disinfection for pure culture work: the use of hypochlorites. Ann. Missouri Bot. Gard. **6**: 159–170. Ap 1919.

Ensign, M. R. Gas injury to wheat. Phytopathology **9**: 266. 24 Je 1919.

Evans, A. W. A new *Riccia* from Peru. Torreya **19**: 85–88. *f. 1*. 9 Jl 1919.

Riccia bistriata sp. nov.

Falk, K. G., McGuire, G., & Blount, E. Studies on enzyme action—XVII. The oxidase, peroxidase, catalase, and amylase of fresh and dehydrated vegetables. Jour. Biol. Chem. **38**: 229–244. Je 1919.

Farwell, O. A. *Tsuga americana* (Mill.) Farwell, a final word. Rhodora **21**: 108, 109. Je 1919.

Fernald, M. L. *Panicum* § *Capillaria* in New England. Rhodora **21**: 110–114. Je 1919.
Paricum Tuckermani sp. nov. is described.

Fromme, F. D., & Wingard, S. A. Bean rust. Virginia Agr. Exp. Sta. Bull. 220: 1–18. *pl. 1–5*. N 1918.

Gleason, H. A. What is ecology? Torreya **19**: 89–91. 9 Jl 1919.

Graves, E. W. The botrychiums of Mobile County, Alabama. Am. Fern Jour. **9**: 56–58. Jl 1919.

Griffiths, D. New and old species of *Opuntia*. Bull. Torrey Club **46**: 195–206. *pl. 9, 10*. 8 Jl 1919.
Eight new species are described.

Güssow, H. T. Establishment of an imperial (British) Bureau of Mycology. Phytopathology **9**: 265. 24 Je 1919.

Haas, A. R. C. Anesthesia and respiration. Science II. **46**: 462–464. 9 N 1917.

Harper, R. M. A forest reconnaissance of the Delaware Peninsula. Jour. Forestry **17**: 546–555. My 1919. [Map]

Haskell, R. J. *Fusarium* wilt of potato in the Hudson River valley, New York. Phytopathology **9**: 223–260. *pl. 13–15*. 24 Je 1919.

Higgins, B. B. Gum formation with special reference to cankers and decays of woody plants. Georgia Agr. Exp. Sta. Bull. 127: 23–51. *pl. 1–6*. + *f. 1, 2*. Ja 1919.

Higley, R. Notes on *Cephaleuros virescens*. Trans. Illinois Acad. Sci. **10**: 256–258. 1917.

Hughes, F. T. Botany in the city high schools. Torreya **19**: 57–65. 25 Je 1919.

Hunnicutt, B. H. A forage plant from the Solanaceae family. Jour. Heredity **10**: 185–187. *f. 14, 15*. 26 My 1919.

Johnson, J. The influence of heated soil on seed germination and plant growth. Soil. Sci. **7**: 1–103. *pl. 1–8*. Ja 1919.

Johnson, J., & Hartman, R. E. Influence of soil environment on the rootrot of tobacco. Jour. Agr. Research **17**: 41–86. *pl. 1–7*. 15 My 1919.

King, C. A. Changes in teaching biology in our high schools. Torreya **19**: 65–71. 25 Je 1919.

Kylin, H., & Skottsberg, C. Zur Kenntnis der subantarktischen und antarktischen Meeresalgen—II. Rhodophyceen. Wissenschaftliche Ergebnisse der Schwedischen Südpolar Exp. 1901–1903. 4: 1–88. *pl. 1* + *f. 1–38*. 1919.

Lillo, M. Segunda contribucion al conocimiento de los arboles de la Argentina. 1–69. Tucuman. 1917.

Long, B. *Jasione montana* a conspicuous weed near Lakewood, New Jersey. Rhodora **21**: 105–108. Je 1919.

Lutman, B. F. Osmotic pressures in the potato plant at various stages of growth. Am. Jour. Bot. **6**: 181–202. *f. 1, 2.* My 1919.

MacDougal, D. T. Growth in organisms. Science II. **49**: 599–605: 27 Je 1919.

Mackenzie, K. K. *Eupatorium maculatum.* Addisonia **4**: 23, 24. *pl. 132.* 30 Je 1919.

Mann, P. B. The relation of first year botany to advanced work, with reference to certain applications and by-products. Torreya **19**: 72–78. 25 Je 1919.

Maxon, W. R. Ferns of the District of Columbia. Am. Fern Jour. **9**: 38–48. Jl 1919.

Maxon, W. R. A new *Alsophila* from Guatemala and Vera Cruz. Proc. Biol. Soc. Washington **32**: 125–129. 27 Je 1919.
Alsophila scabriuscula sp. nov.

MacInnes, F. J. The occurrence of *Alternaria* in a characteristic apple spot, and an apple rot caused by *Gliocladium viride.* Trans. Illinois Acad. Sci. **10**: 218–229. *pl. 1–4.* 1917.

McAtee, W. L. Summary of notes on winter blooming at Washington, D. C. Proc. Biol. Soc. Washington **32**: 129–132. 27 Je 1919.

McLean, R. C. Studies in the ecology of tropical rain-forests: with special reference to the forests of south Brazil. Jour. Ecol. **7**: 5–54. *pl. 1 + f. 1–21.* My 1919.

Melhus, I. E., & Rhodes, L. L. A quick method of eliminating seed-borne organisms of grain. Science II. **50**: 21. 4 Jl 1919.

Miles, L. E. Some new Porto Rican fungi. Trans. Illinois. Acad. Sci. **10**: 249–255. *f. 1–3.* 1917.
Includes new species in *Mycosphaerella* (9), *Helminthosporium* (1), *Cercospora* (1).

Nash, G. V. *Crataegus macrosperma.* Addisonia **4**: 35. *pl. 138.* 30 Je 1919.

Nash, G. V. The digger pine in the botanical garden. Jour. N. Y. Bot. Gard. **20**: 127, 128. Je 1919.

Nash, G. V. *Malus Halliana.* Addisonia **4**: 27. *pl. 134.* 30 Je 1919.

Nash, G. V. *Oxydendrum arboreum.* Addisonia **4**: 37, 38. *pl. 139.* 30 Je 1919.

Payson, E. B. The North American species of *Aquilegia*. Contr. U. S. Nat. Herb. **20**: 133–157. *pl. 8–15*. 1919.
Four new species are described.

Pellegrin, F. Quelques remarques sur les Dioscoréacées du Paraguay. Bull. Soc. Bot. Genève **10**: 383–388. 1918.

Pennell, F. W. *Penstemon calycosus*. Addisonia **4**: 31, 32. *pl. 136*. 30 Je 1919.

Pepoon, H. S. The primrose rocks of Illinois. Trans. Illinois Acad. Sci. **10**: 159–162. 1917. [Illust.]

Petch, T. Citrus mildew: a correction. Phytopathology **9**: 266. 24 Je 1919.

Pipal, F. J. White top and its control. Purdue Univ. Agr. Exp. Sta. Circ. 85: 1–12. *f. 1–8*. D 1918.

Pring, G. H. Orchids of the Missouri Botanical Garden, St. Louis. Mo. Gard. Chron. Am. **23**: 208, 209. Je 1919. [Illust.]

Roberts, H. F. The founders of the art of breeding—II. Jour. Heredity **10**: 147–152. *f. 1* + *frontispiece*. 26 My 1919.

Roberts, R. H. "Crinkle" on northwestern greening. Phytopathology **9**: 261–263. *pl. 16, 17*. 24 Je 1919.

Rock, J. F. Cyrtandreae Hawaiienses, sect. *Microcalyces* Hillebr. Am. Jour. Bot. **6**: 203–216. *pl. 29–32*. My 1919.
Cyrtandra Giffardii, *C. limosiflora*, *C. montis Loa*, *C. ramosissima*, and *C. Hashimotoi*, spp. nov., are described.

Sayre, J. D. Comparative transpiration of tobacco and mullein. Ohio Jour. Sci. **19**: 422–426. *f. 1*. My 1919.

Schaffner, J. H. The nature of the dioecious condition in *Morus alba* and *Salix amygdaloides*. Ohio Jour. Sci. **19**: 409–416. My 1919.

Schmitz, H. Studies in the physiology of the fungi—VI. The relation of bacteria to cellulose fermentation induced by fungi, with special reference to the decay of wood. Ann. Missouri Bot. Gard. **6**: 93–136. Ap 1919.

Selby, A. D. Apple blotch, a serious fruit disease. Bull. Ohio Agr. Exp. Sta. 333: 491–505. *f. 1–5*. F 1919.

Seward, A. C. Recent paleobotany in Great Britain. Science II. **50**: 43–48. 11 Je 1919.

Small, J. K. *Heliotropium Leavenworthii*. Addisonia **4**: 29, 30. *pl. 135*. 30 Je 1919.

Small, J. K. *Heliotropium polyphyllum*. Addisonia **4**: 25, 26. *pl. 133*. 30 Je 1919.

Small, J. K. *Rhabdadenia corallicola.* Addisonia **4**: 33, 34. *pl. 137.* 30 Je 1919.

Small, J. K. *Urechites pinetorum.* Addisonia **4**: 21, 22. *pl. 131.* 30 Je 1919.

Smith, E. F., Jones, L. R., & Reddy, C. S. The black chaff of wheat. Science II. **59**: 48. 11 Je 1919.

Southworth, W. Twining in alfalfa. Jour. Heredity **10**: 182. *f. 12, 13.* 26 My 1919.

Stakman, E. C. Destroy the common barberry. U. S. Dept. Agr. Farm. Bull. 1058: 1–12. *f. 1–6.* My 1919.

Steil, W. N. Apospory in *Pteris sulcata* L. Bot. Gaz. **67**: 469–482. *pl. 16, 17.* 21 Je 1919.

Stevens, F. L. An apple canker due to *Cytospora.* Illinois. Agr. Exp. Sta. Bull. 217: 367–379. *f. 1–15.* Mg 1919. [Illust.]

Stevens, F. L. Porto Rican fungi, old and new. Trans. Illinois Acad. Sci. **10**: 162–218. *f. 1–13.* 1917.

Includes *Dimeriopsis, Hyalosphaera, Borinquenia, Dexteria, Monogrammia,* and *Microclava,* gen. nov., and 53 new species in various genera.

Stevens, F. L., & True, E. Y. Black spot of onion sets. Illinois Agr. Exp. Sta. Bull. 220: 507–532. *f. 1–19.* My 1919.

Describes *Cleistothecopsis* gen. nov.

Tehon, L. R. Studies of some Porto Rican fungi. Bot. Gaz. **67**: 501–511. *pl. 18.* 21 Je 1919.

New species are described in *Meliola* (4), *Phyllachora* (2), *Stigmatea* (1), *Phaeosphaerella* (1), *Coniothyrium* (1), *Pestalozzia* (1), *Acrothecium* (1), and *Trichostroma* (1).

Tracy, S. M. Rhodes grass. U. S. Dept. Agr. Farm. Bull. 1048: 1–14. *f. 1–3.* Je 1919.

Trelease, W. The chestnut in Illinois. Trans. Illinois Acad. Sci. **10**: 143–145. 1917.

Tuttle, G. M. Induced changes in reserve materials in evergreen herbaceous leaves. Ann. Bot. **33**: 201–210. *f. 1–7.* Ap 1919.

Waterman, W. G. Plant ecology and its relation to agriculture. Trans. Illinois Acad. Sci. **10**: 123–129. 1917.

Williams, R. S. The genus *Desmatodon* in North America. Bull. Torrey Club **46**: 207–220. *pl. 11.* 8 Je 1919.

Winslow, E. J. Early days of the American Fern Society. Am. Fern Jour. **9**: 33–38. Jl 1919.

Woodward, R. W. Some Connecticut plants. Rhodora **21**: 114–116. Je 1919.